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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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MAR 29 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

PR Docket No. 93-61
RM-8013

In the Matter of)

Amendment of Part 90 of the)
Commission's Rules to Adopt)
Regulations for Automatic)
Vehicle Monitoring Systems)

REPLY COMMENTS OF
SOUTHWESTERN BELL MOBILE SYSTEMS, INC.

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Exhibit A	Declaration of B. Keith Rainer
Exhibit B	Initial Review Indicates No Harmful Interference Between Locate One and Part 15 Devices

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Southwestern Bell Mobile Systems, Inc. ("SBMS"), by its attorneys, pursuant to Section 1.415 of the Commission's Rules and in accordance with recent notices released by the Commission,^{1/} hereby replies to further written comments submitted by a number of parties in this proceeding regarding the most efficient and practical method of permanently allocating the 902-928 MHz band for the provision of the Location and Monitoring Services ("LMS").^{2/}

I- SUMMARY AND INTRODUCTION

The additional comments filed in this docket clearly demonstrate that the best available options to allocate LMS remain SBMS' allocation proposals. SBMS' proposals are superior to those of other wide band proponents because they are specifically efficient and promote competition. Moreover they have received qualified support from independent organizations. While SBMS'

^{1/} See Public Notice, DA 94-129, released February 9, 1994, and the Orders in PR Docket No. 93-61, DA 94-178, released February 25, 1994, and DA 94-242, released March 18, 1994.

^{2/} See Notice of Proposed Rulemaking, 8 FCC Rcd. 2502 (1993) ("NPRM").

proposals may not please all parties, no other party in this proceeding has offered a proposal that truly maximizes wide band competition, preserves a home for genuine narrow band systems (i.e., 2 MHz or less) and leaves the status of Part 15 devices undisturbed.

If the Commission decides to defer a final decision until additional empirical evidence is produced in this proceeding, such information will be available upon completion of the research now being undertaken by the Mobile Portable Radio Research Group of the Bradley Department of Electrical Engineering at Virginia Tech (hereinafter "MPRG").

II- ONE OF SBMS' ALLOCATION PROPOSALS SHOULD BE ADOPTED

Adoption of any one of the three proposals SBMS advocates in this proceeding (each of which is designed to accommodate various band users while recognizing individual rights to exist in shared spectrum) offers the best prospect for allocating the 902-928 MHz band in a spectrally efficient manner.

Responding to the Commission's call for assistance in the NPRM, SBMS in its original Comments advocated the licensing of wide band and narrow band carriers in separate spectrum.^{3/} SBMS initially advocated two options of licensing multiple wide band

^{3/} See Comments of SBMS, PR Docket No. 93-61 (filed June 29, 1993) (hereinafter "SBMS Original Comments").

providers, proposing the assignment of at least four separate 4 MHz wide band allocations in each market area.^{4/}

In its continuing effort to play a constructive role in this docket, SBMS more recently proposed a third alternative allocation scheme designed to particularly accommodate existing wide band licensees by shifting the proposed wide band assignments by two MHz to 906-910 MHz (Wide Band A), 910-914 MHz (Wide Band B), 916-920 MHz (Wide Band C) and 920-924 MHz (Wide Band D).^{5/} Any of its three alternative proposals would be acceptable to SBMS.^{6/}

The SBMS allocation schemes and the proposals of other parties in this proceeding have been analyzed by Mr. B. Keith Rainer of Southwestern Bell Technology Resources ("SBTR") whose Declaration is attached herewith as Exhibit A. According to Mr. Rainer, the proposals offered by SBMS are superior to those of the other

^{4/} The bands proposed by SBMS included 904-908 MHz (Wide Band A), 908-912 MHz (Wide Band B), 918-922 MHz (Wide Band C) and 922-926 MHz (Wide Band D). SBMS offered two alternatives within this framework. Under SBMS' preferred plan the forward links utilized by wide band providers would be located in separate spectrum assignments of 250 kHz each at the edges of the 902-928 MHz band to minimize interference. As an alternative, primarily to accommodate the interests of narrow band operators by freeing up an additional one MHz, SBMS offered to accept assignment of the forward links inside each four MHz wide band allocation.

^{5/} See Letter from Robert L. Hoggarth to William F. Caton dated February 2, 1994) and its latest Comments filed March 15, 1994 (hereinafter "SBMS Comments").

^{6/} In its original Comments SBMS advocated relocation of narrowband AVM systems over a three year period. SBMS has not advocated the relocation of existing short range wide band systems. SBMS would support the grandfathering of those short range systems for which applications were filed before the release of the Notice of Proposed Rulemaking ("NPRM") in this proceeding. 8 FCC Rcd 2502 (1993).

parties because they maximize spectral efficiency and competition opportunities.

The foundation of SBMS' proposals is the assignment of four 4 MHz wide channels approximately in the same band location as the current interim AVM allocations. Mr. Rainer finds that this allocation scheme is superior to those proposed by other parties because it maximizes spectral efficiency and competitive opportunities. First, it minimizes any dislocation effects and expenses on currently operating systems and subscribers to those systems. Second, although the proposals accommodate the wide band signal portion of systems advocated by Teletrac, MobileVision, and SBMS,^{1/} they would not necessarily prevent LMS system operators from obtaining additional licenses in more than one of the four proposed channels if spectrum were available and under very limited and tightly controlled circumstances.

SBMS' proposals are superior to those of other wide band proponents that are either not spectrally efficient (e.g., the time sharing schemes of Teletrac and Pinpoint will waste valuable spectrum) or are competitively inadequate (e.g., MobileVision's desire to, inter alia, allocate only two 8 MHz carriers in each market).

Mr. Rainer observes that the SBMS proposals allow wide band system operators to have a predictable radio environment in which to offer a quality radio service. The proposals foster a

^{1/} All three parties have asserted the ability to operate location service in 4 MHz bandwidth.

competitive service environment with accommodations for four LMS systems to provide service in any market. The proposals are spectrally efficient and have received qualified support from representatives of independent organizations.^{8/} They allow system operators the maximum freedom for system enhancements, and they provide spectrum to non-wide band operators like Part 15 devices and narrowband LMS systems that is clear from any potential wideband LMS system interference, thus preserving their use of the 902-928 MHz band.^{9/}

III- IF THE COMMISSION DEFERS ISSUING PERMANENT LMS RULES
IT SHOULD REFER TO THE RESEARCH BEING CONDUCTED BY MPRG

A number of participants in this proceeding claim that a definitive agreement must be reached regarding the capacity of the AVM band to accommodate different users before permanent LMS rules can be issued.^{10/} If the Commission decides to defer establishing

^{8/} In comments regarding the Teletrac system, Dr. Jay Padgett of TIA has suggested that two 4 MHz bands would actually provide more capacity than one 8 MHz band. See Comments of TIA, Exhibit A (filed March 15, 1994). Mr. Rick Cameron and Dr. Brian Woerner also suggest in the MPRG Report that SBMS' approach would be a reasonable method of spectrum sharing that is preferable to time sharing.

^{9/} Furthermore, the SBMS proposals establish bands for the forward links used by wide band LMS systems. The links, which would preferably be located at the band edges, could also be used to provide ancillary emergency voice services without any adverse effects on the radiolocation and data messaging functions for which this spectrum is principally intended.

^{10/} In its further comments The Mobile and Personal Communications Consumer Radio Section of the Telecommunications Industry Association ("TIA") asserts that further action in this proceeding is premature because the record, including the recent report provided by MPRG, suggests that a number of key technical questions
(continued...)

permanent rules at this time, the research being conducted by MPRG can assist this process. The research is being conducted by an eminently qualified organization. That organization should be given every opportunity to complete its work.

A. MPRG Is Uniquely Qualified To Study The
902-928 MHz Band

As SBMS described in its recent comments, MPRG is uniquely suited to undertake an independent and objective analysis of the 902-928 MHz band. In recent years MPRG has been an active contributor of research in areas with direct application to AVM systems including: measurement, simulation and prediction of the mobile communications channel; analysis and simulation of spread spectrum systems; and research into advanced techniques for interference rejection.

B. MPRG Has Already Initiated A Study Of
The 902-928 MHz Band

After preliminary discussions with SBMS, in October 1993 MPRG agreed to undertake a four phase study to investigate the issues of spectrum sharing and interference for systems operating in the 902-

^{10/}(...continued)

remain unanswered. See Comments of TIA (filed March 15, 1994). TIA asserts that "the information which [MPRG] proposes to develop is a prerequisite to a well-founded Rule Making." Id. at 3. TIA urges development of industry standards to allow interoperability among systems sharing the 902-928 MHz band.

MobileVision has also gone on the record suggesting that if the Commission is not prepared to adopt MobileVision's proposal that it convene an informal technical meeting among the Commission staff and industry representatives to establish a full record of technical, economic and market requirements on which the LMS rules can be based. See Comments of MobileVision at 33 (filed March 15, 1994) (hereinafter "MobileVision Comments").

928 MHz band.^{11/} During those discussions, other parties to this proceeding were contacted and invited to participate in the funding of the research but declined to participate.^{12/} As a result, SBMS has borne sole responsibility for funding the MPRG research and presenting interim results of that work to the Commission.^{13/}

C. MPRG Has Produced An Interim Report Of Its Research

Due to the Commission's original interest in concluding this docket as soon as possible, MPRG agreed in October 1993 to immediately initiate efforts on Phase 1 of its study. Although Phase 1 would take approximately nine months to complete, MPRG agreed to produce an interim progress report within 90 days for submission to the Commission. The goal of the interim report was to advise the Commission of the status of MPRG's efforts to date

^{11/} As SBMS explained in its Comments, the first study phase, which will be completed in July 1994, analyzes trade offs between LMS system performance and bandwidth. The subsequent phases, which will proceed simultaneously and take an additional ten months, will investigate and evaluate (1) alternative techniques for sharing among LMS systems (Phase 2), (2) proposed standards for LMS operations (Phase 3), and (3) interference resistance among rival systems operating in the 902-928 MHz band (Phase 4).

^{12/} Other efforts were made to bring commenters together to discuss a common ground at an early stage of this proceeding. No actual progress was ever achieved. SBMS offered to participate in an examination of the technical issues associated with the AVM/LMS docket proposed by the Telecommunications Industry Association ("TIA") last year. See September 20, 1993 letter from C.C. Bailey of Southwestern Bell Technology Resources to Eric Shimmel of TIA (copy attached to Exhibit A hereto).

^{13/} SBMS' dual role as funder and presenter of the preliminary results of the research should not in any way cast doubt upon the wholly independent nature of the work MPRG has undertaken. While SBMS was initially the sole funder of the MPRG research, due to MPRG's work regarding this proceeding, the Department of Transportation, Federal Highway Administration, has provided matching funds to MPRG for it to expand the scope of its research.

and to highlight preliminary conclusions for the Commission to consider in the context of its proceeding. That report, entitled "Capacity and Interference Resistance of Spread-Spectrum Automatic Vehicle Monitoring Systems in the 902-928 MHz ISM Band" (hereinafter "MPRG Report"), was presented to the Commission staff on February 1, 1994.

In view of the initial goals of the MPRG Report and MPRG's efforts to produce it, criticism of the Report's conclusions as "incomplete and misleading"^{14/} are without support and totally inappropriate.

Even as the Commission proceeds with allocation of the AVN spectrum, MPRG's research will continue. At the very least the Commission and users of the band may benefit from MPRG's identification and development of tools to mitigate the forms of interference that may exist in the band.

IV- FINAL LMS RULES SHOULD LIMIT MOBILE UNIT POWER
AND IMPOSE LOCATION ACCURACY STANDARDS

Of the various constraints and standards that must be codified in the final LMS rules, SBMS believes that limits on mobile unit power and minimum standards for location accuracy are among the most critical. Absent power limits, the likelihood of co-channel interference and its attendant adverse effects is high. Without accuracy requirements, no mechanism will exist to screen

^{14/} See Comments of Pinpoint Communications, Inc. ("Pinpoint"), Exhibit B at 1 (filed March 15, 1994) (hereinafter "Pinpoint Comments").

inefficient operators and technologies from access to scarce LMS spectrum.

Among the wide-band operators participating in this proceeding, Pinpoint recommends allowing mobile units to operate at a transmit power of 50 watts.^{15/} In the SBMS system design, by contrast, the transmit power out of the mobile units is only 10 watts. As explained in Mr. Rainer's Declaration (Exhibit A hereto), Pinpoint's abnormally high power to completed mobile-to-base transmission may be required to overcome deficiencies in system design, like susceptibility to interference or high bit error rate, etc. (See Section VIII, D., infra.). In addition to reflecting flaws in its system design, Pinpoint's affinity for high mobile power will also aggravate interference with co-channel users, increase the potential for adverse economic consequences and increase component costs.

SBMS also supports establishment and codification of specific benchmarks for construction and service of wide band LMS systems. Such standards will limit access to LMS spectrum to operators who can satisfy reasonable service requirements while excluding inefficient operators and technologies. SBMS agrees with Teletrac that one important service benchmark should be location accuracy. Teletrac suggests that a system achieve "location accuracy of 300

^{15/} In its further comments, Uniplex Corporation advocates a 30 watt limit on mobile unit power. See Further Comments of Uniplex Corporation (filed February 25, 1994).

feet."^{16/} SBMS suggests that a more measurable requirement be 90 percent of all locates be accurate to within 300 feet.^{17/}

V- AVM/LMS SPECTRUM IS DESIGNED TO BE AND SHOULD REMAIN
A NON-VOICE SERVICE

The NPRM in this proceeding, with good reason, unambiguously characterizes LMS as a non-voice service.^{18/} Wireless voice services are numerous and expanding.^{19/} Considering the profusion of voice-based services, transforming LMS into another voice service is neither warranted nor consistent with the Commission's proposed definition of LMS as "use of non-voice signalling methods from and to radio units to make known the location of such units."^{20/}

SBMS' revised proposal adheres most closely to the Commission's original intent in defining LMS as a non-voice

^{16/} See Comments of Teletrac at 7 (filed March 15, 1994).

^{17/} Furthermore, SBMS advocates that an operator be required to serve 90% of the land area of an MSA license and 50% of an RSA's land area.

^{18/} NPRM, 8 FCC Rcd. at 2503.

^{19/} Consumers can presently select from common carrier cellular and conventional mobile telephone service, and from private carrier radio services, including SMR operations and conventional and trunked radio systems. Moreover, PCS, mobile satellite and other satellite-based voice services are imminent. Furthermore, a proposal to use 28 GHz spectrum to provide voice and other services is pending before the Commission.

^{20/} NPRM, 8 FCC Rcd at 2503 (emphasis added).

service.^{21/} Pinpoint and AMTECH also reject the need for anything but incidental voice communications.^{22/}

The intentions of some other parties regarding LMS voice service, by contrast, continue to raise serious questions. Teletrac boldly proclaims that LMS licensees should be able to offer real time voice transmissions as a component of emergency roadside or personal services. MobileVision has also urged that LMS incorporate "unrestricted voice and high speed data capability to meet service needs."^{23/}

^{21/} In its initial comments in this proceeding, SBMS proposed a limited expansion of the definition of LMS to include communication/interrogation of radio units with known locations to facilitate monitoring of security systems, industrial appliances, vending machines, pipelines, storage terminals, etc. See SBMS Original Comments at 6. Even under this expanded definition, however, LMS remains a non-voice service.

^{22/} See Comments of Pinpoint at 23 (filed March 15, 1994) (hereinafter "Pinpoint Comments") (voice should play only a limited and auxiliary role); see also Comments of AMTECH Corporation at 7 (filed March 15, 1994) (voice communications incidental to vehicle location should only be permitted in wide band forward links).

^{23/} See Letter to Ralph H. Haller, Chief, Private Radio Bureau by counsel for MobileVision, dated February 1, 1994. MobileVision asserts in its further comments that the economic viability of all LMS systems (if not its own) depends on voice service capabilities. MobileVision Comments at 15.

Mr. Keith Rainer notes that MobileVision has designed narrowband voice channels located in the side lobes of its 4 MHz wide band signal. See Exhibit A at 10. Ironically, according to Mr. Rainer, MobileVision's design implements exactly what SBMS has intended to achieve in its proposals to allocate adjacent 4 MHz wide band channel allocations. If MobileVision can operate voice channels in its side lobes, then it seems reasonable that another licensee can operate the wide band portion of its own radiolocation system in an adjacent channel.

Because these proposals apparently provide for unconstrained two-way voice and dispatch communications, they should be rejected by the Commission as being directly contrary to the Commission's policy objectives for LMS.^{24/} To allow LMS licensees to provide voice will fundamentally distort the purpose of LMS, encourage spectrum congestion, and will preclude this service from meeting the radiolocation needs for which it was intended.

VI- THE ADDITIONAL COMMENTS SUPPORT AN MSA/RSA LICENSING STRUCTURE FOR AVM/LMS

Throughout this proceeding, SBMS has advocated adopting MSA and RSA service area boundaries for LMS licensing purposes. After reviewing the additional comments, SBMS is convinced that an MSA/RSA framework is superior to the BTA/MTA proposal of Teletrac.

First, the Commission already has experience in using MSA/RSA boundaries in licensing cellular systems. That experience is generally viewed as favorable. Second, MSA/RSA boundary definitions are in the public domain, while BTA/MTA boundaries are copyrighted. Finally, MSA and RSA boundaries are widely known and easily ascertainable.

Other commenters have also concluded that MSA/RSA definitions represent the most efficient and practical market boundaries for

^{24/} Pinpoint agrees with SBMS' assessment. Pinpoint asserts that voice transmissions should play only a limited and auxiliary role to LMS. See Pinpoint Comments at 23. Like SBMS, Pinpoint concludes that the Commission has already set aside numerous bands and established services that can be used for voice in conjunction with LMS including cellular, SMRS, PCS and trunked private band mobile radio. According to Pinpoint, the 902-928 MHz band is the only one with sufficient bandwidth for high-speed radiolocation systems. Pinpoint proposes that voice transmissions be limited to a 250 kHz sub-band and be available for emergency use only.

LMS systems. Pinpoint believes an MSA/RSA licensing scheme will facilitate the licensing process.^{25/} MobileVision also supports MSA/RSA licensing because such a scheme will create defined service area boundaries and will facilitate wide area licensing.^{26/}

VII- THE PROPOSAL TO RELOCATE WIDE-BAND LMS
TO SEPARATE SPECTRUM SHOULD BE REJECTED

Many Part 15 commentators claim that wide-band LMS advocates have inadequately considered how LMS operations will impact Part 15 devices licensed in the AVM band.^{27/} From SBMS' perspective, this claim is unfair and inaccurate. SBMS has always been sensitive to concerns of Part 15 users and is presently evaluating its Chicago system's operation to determine whether and to what extent Part 15 devices will be adversely affected by wide-band LMS. In addition, SBMS specifically requested that an analysis of Part 15 issues be a principal component of the MPRG Study. Furthermore, the Part 15 Coalition was invited to participate in the MPRG Study. For these reasons, claims of neglect by Part 15 proponents lack merit.

Based on its Chicago tests and other evidence, SBMS believes there is no reason to anticipate substantial detrimental impact to Part 15 devices with the advent of wide-band LMS. Accordingly, the recommendation that wide-band LMS be assigned to separate spectrum is ill-advised and should be rejected.

^{25/} See Pinpoint Comments at 32.

^{26/} See MobileVision Comments at 27-28.

^{27/} See Comments of the Consumer Electronics Group of the Electronic Industries Association at 2 (filed March 15, 1994).

A. Part 15 Interference Concerns Are Manageable

Several Part 15 advocates have submitted further comments claiming that any exclusive wide band allocations will result in wide band interference between Part 15 users and LMS operators.^{28/} For that reason Part 15 advocates assert that wide band LMS systems should be allocated spectrum outside the 902-928 MHz band.^{29/}

SBMS is confident that its system will not only handle interference from Part 15 operators, but that it will operate with little interference to Part 15 devices.^{30/} Attached as Appendix B, SBMS reports results of initial analyses regarding its Chicago wide band system's ability to operate without causing or receiving harmful interference from certain Part 15 devices and other users of the band. While implementation is still proceeding, SBMS' system appears capable of coexisting with major brands of 900 MHz

^{28/} The Part 15 Coalition claims that interference potential exists whether wide band systems use 5 MHz or 8 MHz of spectrum. See Comments of Part 15 Coalition at 2 (filed March 15, 1994) (hereinafter "Coalition Comments").

^{29/} See Coalition Comments (advocating relocation to the 2390-2400 MHz band); Comments of TIA (filed March 15, 1994) (suggesting relocation to the 2300-2310 MHz or 2390-2400 MHz bands); and Comments of Ericsson Corporation (filed March 15, 1994); see also Comments of Association of American Railroads ("AAR") (filed February 25, 1994) (AAR, a narrowband advocate, calls for the relocation of AVM systems into the new PCS spectrum).

^{30/} SBMS acknowledges that MPRG anticipates that some interference between AVM systems and certain types of Part 15 devices may occur. MPRG intends to investigate the extent of any potential interference and the methods by which those interference concerns can be minimized or eliminated. Recognizing that MPRG's conclusions will be independent and objective, SBMS is willing to work under any conditions that MPRG's study reveals to be necessary to permit efficient use of the 902-928 MHz band provided all other LMS users do likewise.

cordless telephones. Moreover, SBMS has determined the ability of its system to work in close proximity to a railroad tag reader.

Mr. Keith Rainer has also evaluated the concerns of several Part 15 advocates. According to Mr. Rainer, those fears are unfounded. Rainer notes that SBMS' proposes no change in the current status of Part 15 operators in the 902-928 MHz band. Part 15 devices and operators will have the same design freedom and interference protection experienced under the status quo.^{31/}

Rainer explains that under the SBMS allocation proposals, interference will exist within the 902-928 MHz band much as it exists currently. New and emerging devices will migrate into the band, providing their own contribution to the band segment's noise level, while other devices will migrate out, eliminating their noise contributions. Rainer asserts that selective location of devices operating within the band, as already demonstrated by many developers (such as those of cordless telephones), will minimize interference.^{32/}

^{31/} In general, Part 15 advocates seem to disregard that present regulation affords them only secondary status in the 902-928 MHz band. The NPRM nowhere contemplates changing that status nor does SBMS contemplate diminishing any rights Part 15 users may currently enjoy.

^{32/} Rainer notes that Mr. Graham Smith, of MobileVision, has provided an excellent introductory interference analysis of Part 15 devices and wideband LMS systems. See Comments of MobileVision, Annex 2 (filed March 15, 1994).

B. Relocation Of Wide Band LMS Is Not Justified

Several Part 15 commenters advocate relocation of wide band AVM/LMS systems to another band.^{33/} The position, however, is not justified. Questions of truly harmful interference are still anecdotal. Moreover, Part 15 operators are secondary users of the AVM band who technically merit no special protection. According to Mr. Rainer, relocation would be inappropriate and unfair to wide band LMS providers. He states that the only spectrum presently allocated for AVM service is in the 900 MHz band and it is to the requirements of this band that wide band systems have been developed and implemented. Rainer notes that Part 15 entities never had primary or co-equal status in the band; moreover substantial segments of other bands are available for their use, including (but not limited to) 100 MHz in the 2.4 to 2.5 GHz band and 150 MHz in the 5.725 to 5.875 GHz band. Rainer states that Part 15 entities can now even target products for the new unlicensed PCS band which provides 20 MHz for voice based systems and 20 MHz for data.

VIII- PINPOINT'S TIME SHARING PROPOSAL SHOULD BE REJECTED

In its Comments, Pinpoint vigorously defends its time sharing allocation plan. Pinpoint asserts that its plan for sharing the entire 902-928 MHz band by wide area and local area AVM systems is possible and practical. To the contrary, SBMS believes Pinpoint's proposal will be devastating to the future of the AVM/LMS band. In the markets where Pinpoint's time sharing scheme is implemented,

^{33/} See Note 33 supra.

system capacity will diminish, service and response delays will increase and it will be impossible to guarantee any level of service to customers in need of personal or vehicular security. If Pinpoint's time sharing scheme were adopted by the Commission, in all likelihood SBMS and other carriers would be forced to abandon their LMS efforts because no viable service could be deployed and marketed to the public.

A. Pinpoint's Time Sharing Scheme

According to Mr. Rainer, Pinpoint's claim that all wide area systems (LMS systems) are suited to time sharing is erroneous.^{34/} While a time sharing scheme could conceivably be developed which would be spectrally efficient for a limited number of systems with nearly identical technologies and network topologies, such a highly constrained framework is plainly incompatible with the highly divergent technologies employed by Teletrac, MobileVision, Pinpoint, and SBMS.

For example, Pinpoint asserts that under its time sharing scheme, time guard bands would required to prevent interference between consecutive users of the band.

For example, Pinpoint asserts that under its time sharing scheme, time guard bands would required to prevent interference between consecutive users of the band. Guard band time is dependent on a number of factors including, for example, range and

^{34/} Pinpoint claims that vehicle location typically involves some sort of time sharing scheme among mobiles within an individual system. See Comments of Pinpoint at 5 (filed March 15, 1994) (hereinafter "Pinpoint Comments").

synchronization. Pinpoint's scheme is faulty regarding a subject as elemental as range. In particular, Pinpoint claims that practical mobile to base station communication range in the 900 MHz band is less than 20 miles. SBMS's Chicago LMS System, however, routinely experiences messaging and locating communication between mobile radio and base stations separated by more than 30 miles using mobile radios with a transmit power output 1/5 of that recommended by Pinpoint. This range difference results in greater guard band time, and leads to system inefficiencies. Other technologies have other guard band requirements which would also have to be adjusted by all operators. Mr. Rainer finds that Pinpoint's guard band time represents additional overhead and, therefore, spectral inefficiencies. These inefficiencies, according to Rainer, would multiply as more dissimilar technologies were accommodated under the plan.^{35/}

Mr. Rainer concludes that under Pinpoint's proposal, each LMS system operator in an area would have their capacity reduced, system delay increased and time required to respond to a request for service by a subscriber increased with each new system entry into the local market. This would make it impossible, Rainer

^{35/} Moreover, in addition to GPS timing adjustments (if GPS were used as a reference), SBMS would be required to resynchronize mobile radios to its own network timing standard in each time slice. This resynchronization time is an overhead that does not currently exist for the SBMS system and would constitute an additional loss in capacity due to time sharing. SBMS' system does not provide a timing reference standard in its forward control links.

finds, to guarantee any level of service to subscribers, many of whom will use LMS for vehicular and personal security.^{36/}

B. Pinpoint's Spectrum Requirements

Although Pinpoint's system can operate in 8 MHz of spectrum,^{37/} Pinpoint has routinely expressed a desire to share a continuous 16 MHz or 26 MHz band of spectrum for wide band systems.^{38/} According to Mr. Rainer, this proposal is contrived to provide Pinpoint with access to as much of the band as possible.^{39/}

C. Pinpoint Mobile Unit Power

Pinpoint's proposals regarding mobile unit power threaten the efficient operation of the band. In addition to advocating

^{36/} SBMS's LMS system in Chicago offers subscribers to its network an emergency response feature (similar features are also provided by Teletrac's and MobileVision LMS systems) which is activated when the subscriber and/or the subscriber's vehicle experiences an emergency event related to personal and/or vehicular security. Normally a subscriber's emergencies cannot be scheduled, they occur unexpectedly and require immediate access to the network. SBMS' network supports unsynchronized unscheduled access for emergency transmissions. The viability of such transmissions will be seriously impaired by Pinpoint's time sharing scheme. According to Mr. Rainer, this is an example of Pinpoint's failure to understand SBMS' AVM technology and an illustration of how Pinpoint's time sharing proposal will create an environment where service quality for AVM/LMS systems could be seriously diminished.

^{37/} See Comments of Pinpoint Communications, Inc., P.R. Docket No. 93-61 at 8 (filed June 29, 1993).

^{38/} Pinpoint attempts to justify this "more is better" philosophy, according to Mr. Rainer, on an erroneous understanding of the relationship of capacity to bandwidth.

^{39/} Pinpoint states that it has no objection to modification of its proposal as long as a 16 MHz of continuous spectrum is provided. See Pinpoint Comments at 3, note 7. Oddly enough, this accommodation is required by no party except Pinpoint.

allocation of all 26 MHz of the 902-928 MHz ISM band for use by wideband LMS service providers, Pinpoint has advocated a permissible output power of as much as 50 watts for the mobile radios used in LMS systems.^{40/}

According to Keith Rainer, Pinpoint's recommendation with respect to the transmit power of LMS mobile units is headed in the opposite direction from every other commercial land mobile radio system of which he is aware. While SBMS, MobileVision, and Teletrac are all moving towards low power levels that will minimize interference to co-channel users of the band and out-of-band system operators, reduce component costs, and mitigate any potential environmental effects, Rainer finds that Pinpoint is moving in the opposite direction advocating a philosophy of simply shouting louder instead of listening more carefully.

Since Pinpoint's direction seems to be contrary to that of the mobile radio industry in general, one could speculate that the high power level that Pinpoint recommends is necessary (1) for Pinpoint to avoid interference (i.e., Pinpoint has a fragile radio system with respect to interference), (2) to keep the bit error rate at an acceptable level in the inefficient data element of their system (again indicating inadequate system design by Pinpoint), (3) to get the signal to noise level up on its system to increase data capacity, or (4) to minimize the number of base stations in the system (at the expense of other co-channel users). In any case,

^{40/} Pinpoint has even suggested that Teletrac's interference problems could be corrected if Teletrac's mobile radios had a higher transmit power.

this approach does not speak well for either Pinpoint's technology or its concern for other users of this band.

D. System Capacity Versus Bandwidth

Pinpoint states that SBMS' four 4 MHz assignments will deny the public of the capacity gains and spectral efficiencies attending wider-bandwidth operation. Pinpoint challenges the MPRG conclusion that there is merely a more-than-linear increase in vehicle location capacity as bandwidth increases, and that data throughput experiences a gain merely proportional to bandwidth increases.

Mr. Rainer challenges Pinpoint's claim. He notes that the theoretical relationship of data capacity to bandwidth is linear.^{41/} The data capacity for a channel, according to Rainer, is given by the well known Hartley-Shannon relationship $C = B \log_2 (1 + S/N)$ bits/sec where C is capacity, B is bandwidth, and S/N is signal to noise.

Rainer finds that an analysis conducted by Dr. Jay Padgett (Chairman, TIA Mobile and Personal Communications) of the Teletrac system location capacity reveals the relationship of bandwidth and capacity in a practical radio system. In a report reproduced in TIA's latest comments, Dr. Padgett explains that doubling the spectrum available to an AVM operator would result in a location

^{41/} This result is for a white noise band-limited Gaussian channel. The actual capacity for a mobile radio channel (due to multipath, noise, etc. as correctly observed by Pinpoint) would be reduced, he states.

capacity improvement of only 40 per cent.^{42/} Dr. Padgett suggests that location capacity could actually be doubled by having two 4 MHz bands instead of one 8 MHz band.^{43/}

Rainer notes that the MPRG Report concludes that data capacity in a channel has at most a linear relationship with bandwidth. MPRG, according to Rainer, determined that while radiolocation capacity may increase at a rate slightly greater than linear with respect to bandwidth, that relationship must be examined further with respect to a practical system design.

Pinpoint claims that the MPRG Report tries to downplay the importance of its observations by arguing that the increase in data throughput is only proportional to bandwidth. According to Pinpoint, SBMS' argument that the increase in data throughput is only proportional to bandwidth is irrelevant, because "all parties other than Pinpoint use a separate channel or 'forward link' for control and data than that used for radiolocation."^{44/} According to Keith Rainer, Pinpoint's conclusions are incorrect. SBMS's statement regarding data throughput is completely relevant, states Rainer, because data from the mobile radio to the base station is sent in the wide band channel. In fact, SBMS' system also has a wideband forward link in the same channel as its wideband reverse link.

^{42/} See TIA Comments, Exhibit A.

^{43/} Dr. Padgett's conclusions with respect to the Teletrac system suggest that SBMS's proposed allocation scheme is the solution that would most benefit the public.

^{44/} Pinpoint Comments at 8.

Finally, Pinpoint claims that SBMS' 4 MHz band proposal would constrain system flexibility and location accuracy because narrower bandwidths lose multipath distortion resolving capability, thereby severely reducing a network's capacity and reducing overall bandwidth utilization. Pinpoint challenges the assertion that increasing bandwidth from 1 MHz to 10 MHz will yield only modest improvements in location capacity. Pinpoint claims that SBMS' conclusions are based on operations using a CW signal, such as those used by cellular telephones, and are not applicable to pulse-ranging AVM systems. To the contrary, according to Rainer, SBMS's conclusion is strongly based on the delay spread found in the mobile radio multipath environment at around 900 MHz. The delay spread is measured by using wide bandwidth pulses of very short duration-- not CW signals. The results are applicable to radiolocation in an environment of a mobile radio operating around 900 MHz, states Rainer, and have been measured for urban and suburban environments by a number of researchers.